

Getting ahead of the curve with fuel cells in the UK

HFC Fueling the Future Now, March 2023

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ADVANCED
PROPULSION
CENTRE UK

Accelerating
Progress

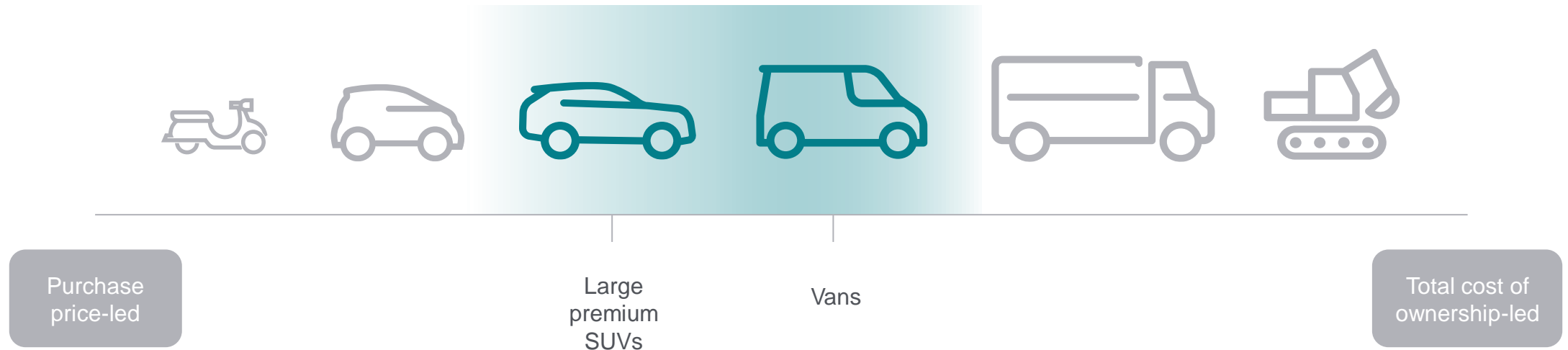
The challenge ahead for SUV and van manufacturers:

Can BEV and FCEV powertrains co-exist on vehicle assembly lines

- Large SUVs and vans are designed to meet a wide range of attributes for different customers, and buying decisions can be TCO and/or purchase price-led. OEMs are more likely to pursue a diversified powertrain strategy.

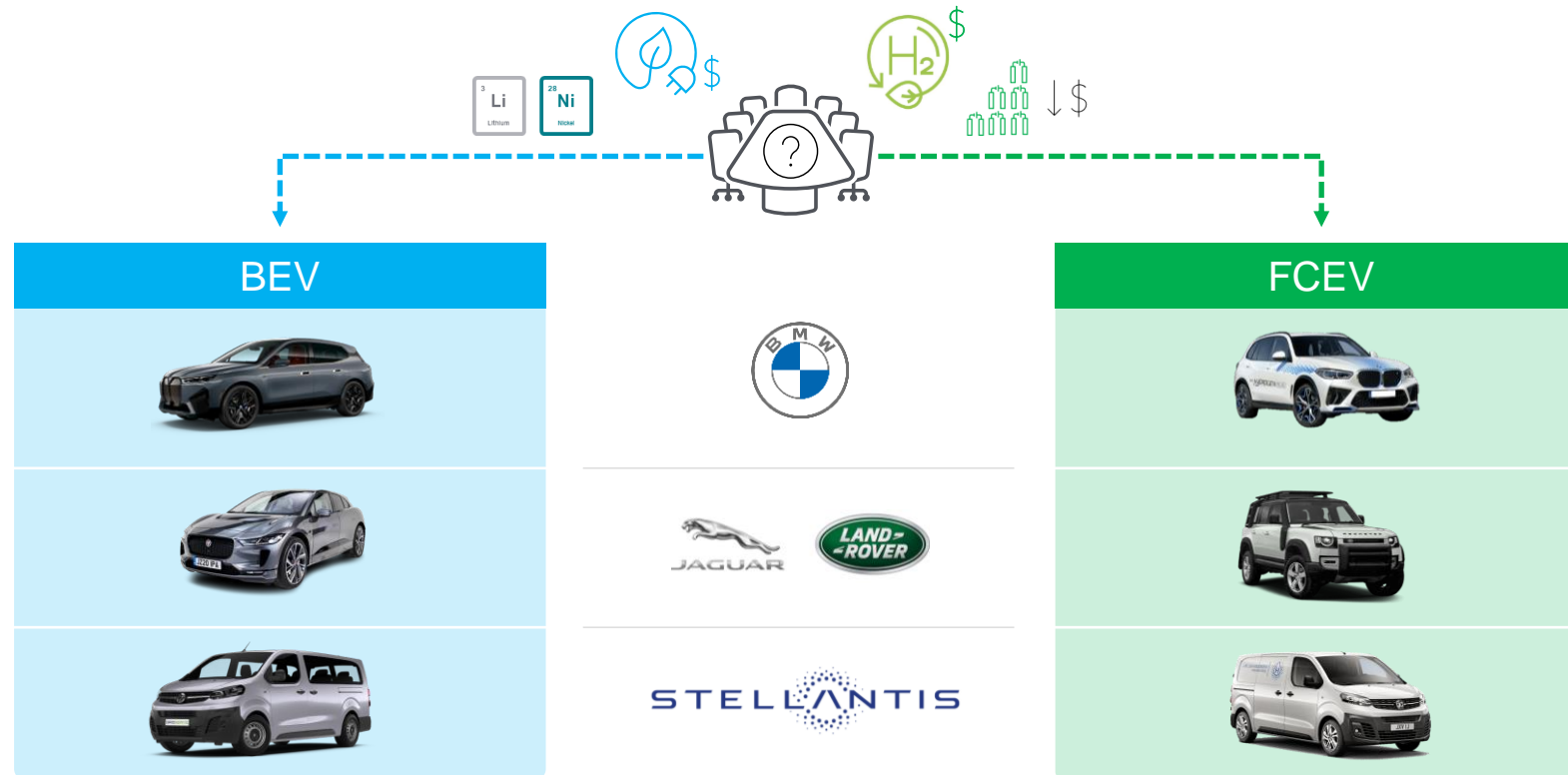
Typical vehicle characteristics

- Medium to high power (150 – 200 kW)
- Long ranges (300+ miles)



Some OEMs are agnostic to the choice between battery and fuel cell powertrains

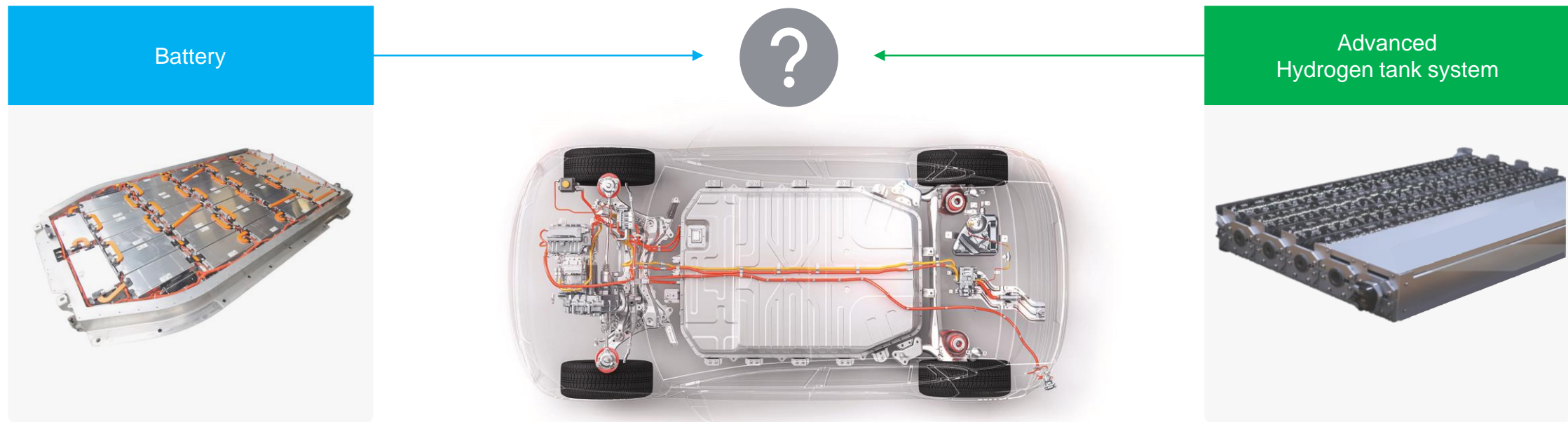
- OEMs are deciding if BEVs are the best option for all vans and SUVs, or if FCEVs can better accommodate some of the more demanding duty cycles.



European OEMs that have publicly announced an interest in battery & fuel cell electric SUVs or vans

Developing a modular electrified platform allows greater adaptability

- Major investments in BEV platforms have preceded FCEV production, but some OEMs could consider a modular electrified platform with interchangeable energy storage options to future-proof vehicle production.

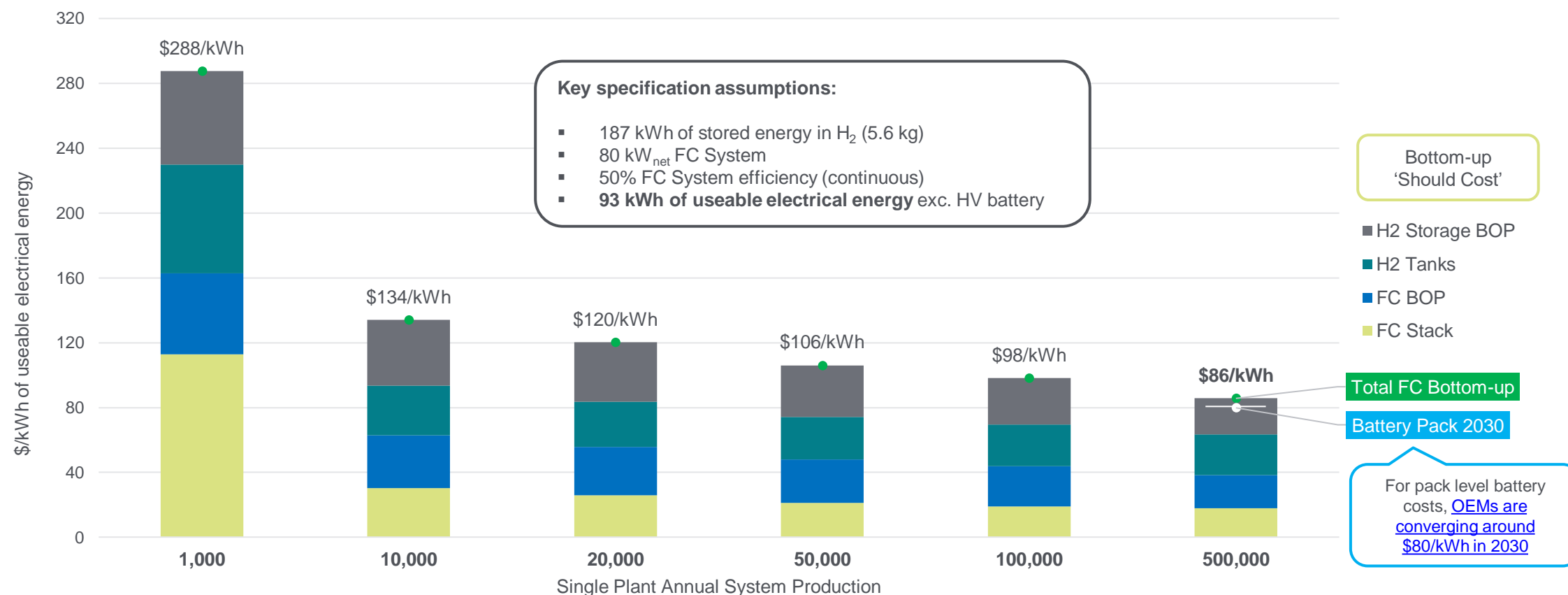


This study assumes that future FCEV models would have a fuel cell system in the front or back of the vehicle, and that the hydrogen tank system would be designed to fit where the battery normally would in a BEV.

APC have a detailed bottom-up cost model for hydrogen fuel cell systems

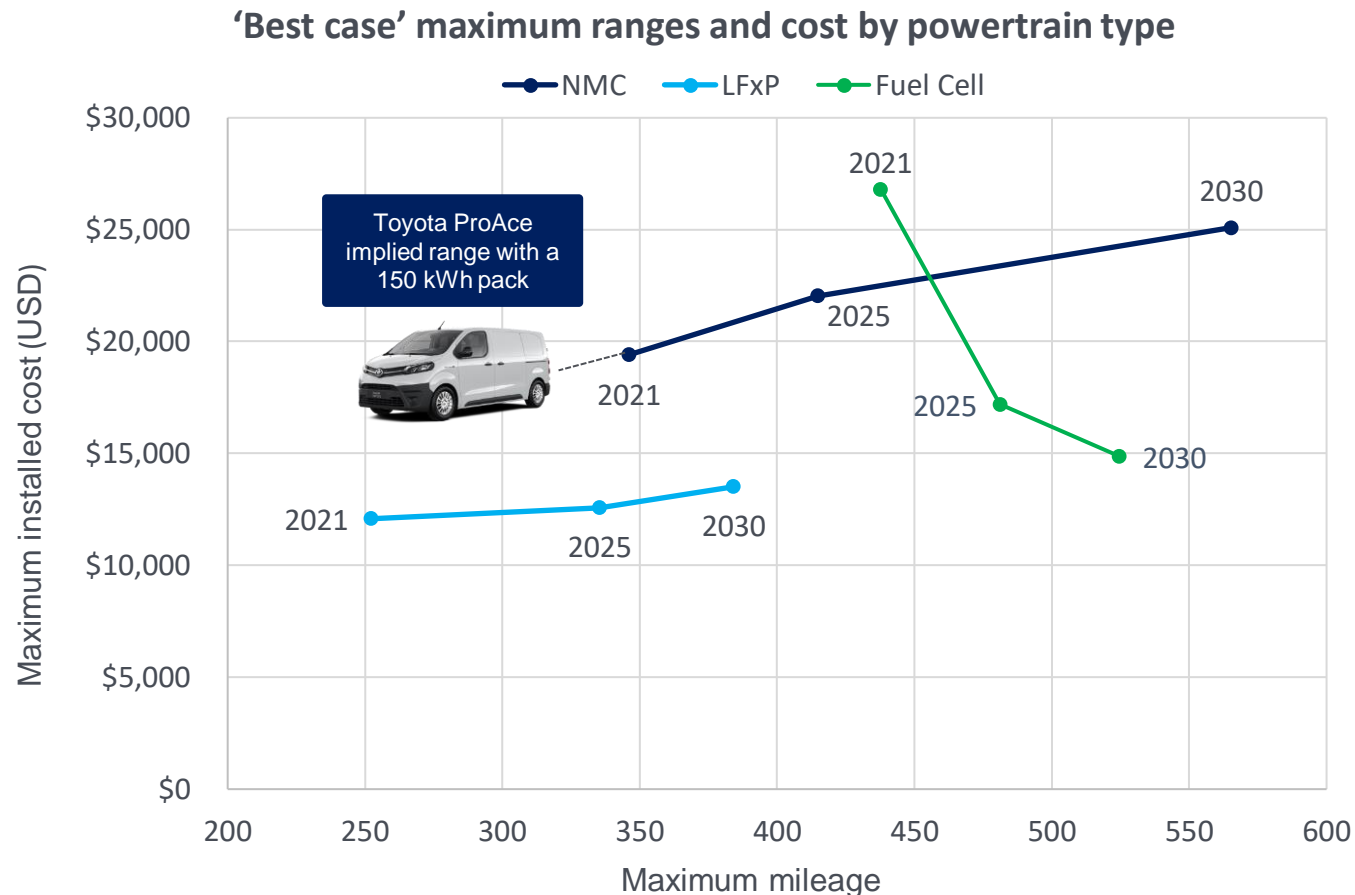
- We have developed a equivalent fuel cell system cost in \$/kWh so we can overlay this with battery costs.
- Our data is based on fuel cell technologies expected in 2030, and shows the economies of scale opportunities.

Light Duty 2030 PEM FC System with Hydrogen Storage Cost*



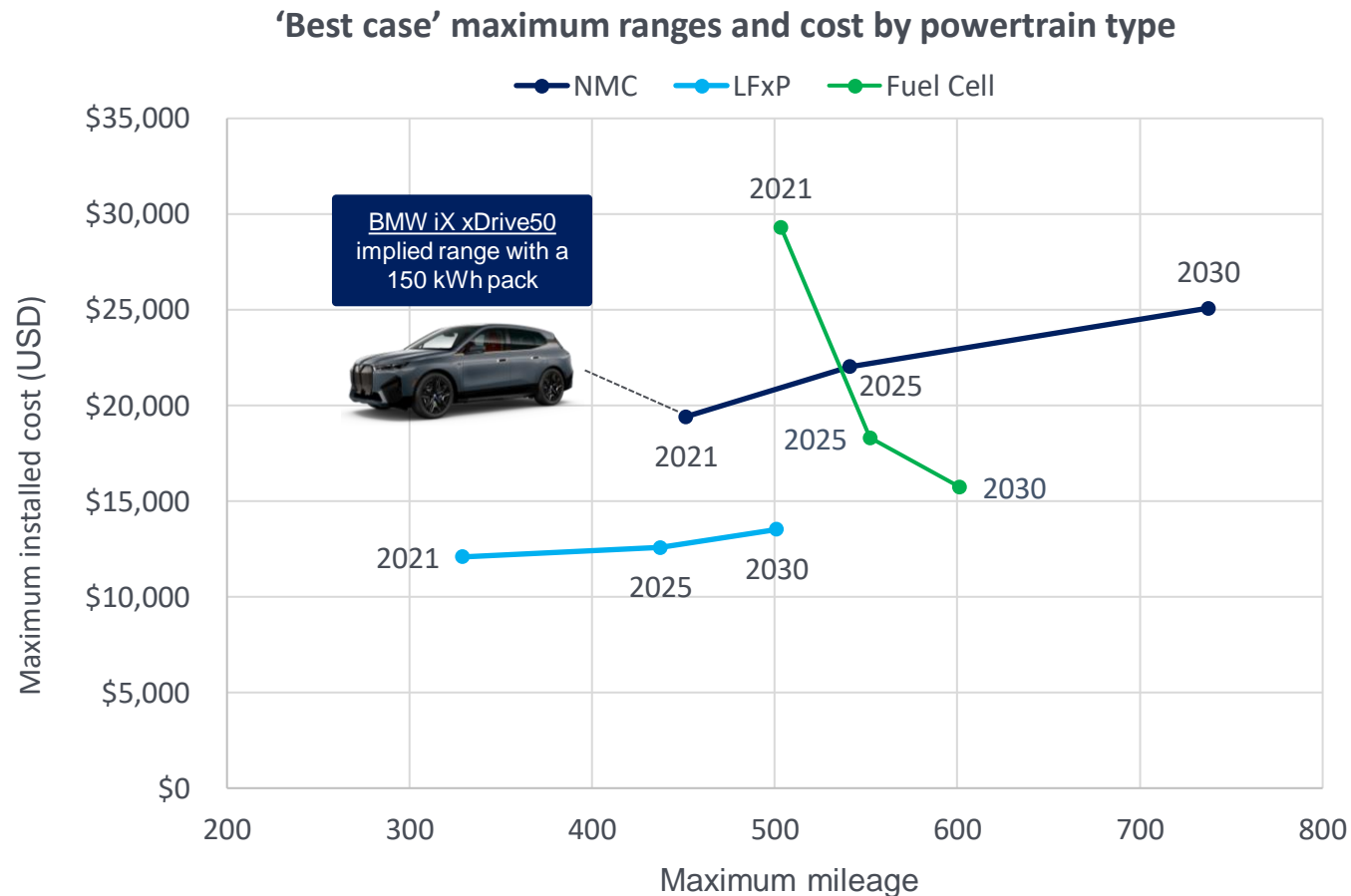
Fuel cells systems offer best powertrain cost option for long-range vans

- By 2030, fuel cells potentially have the lowest installed cost for long-range vans typically doing >400 miles, whereas LFMP batteries would comfortably satisfy the lower range options but incur a payload penalty



Fuel cells offer towing capacity benefits over LFP batteries in SUVs

- If the powertrain packaging space in a large premium SUV is optimised to achieve the highest range possible, then fuel cell systems could achieve 600 miles by 2030, but LFP will likely have the lowest 'cost per mile' by 2030.



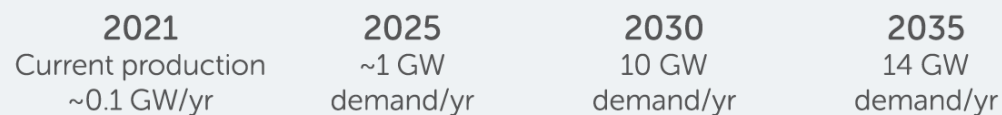
APC expect UK production of FC SUVs and vans to reach 140,000 units by 2035

While early demand will be driven by UK bus and HGV production, the expected ramp-up in SUV and van volumes from 2030 will boost the total UK market opportunity in hydrogen fuel cells and tanks.

14 GW

of fuel cell stacks

required by UK vehicle manufacturers by 2035 for cars and vans produced in the UK



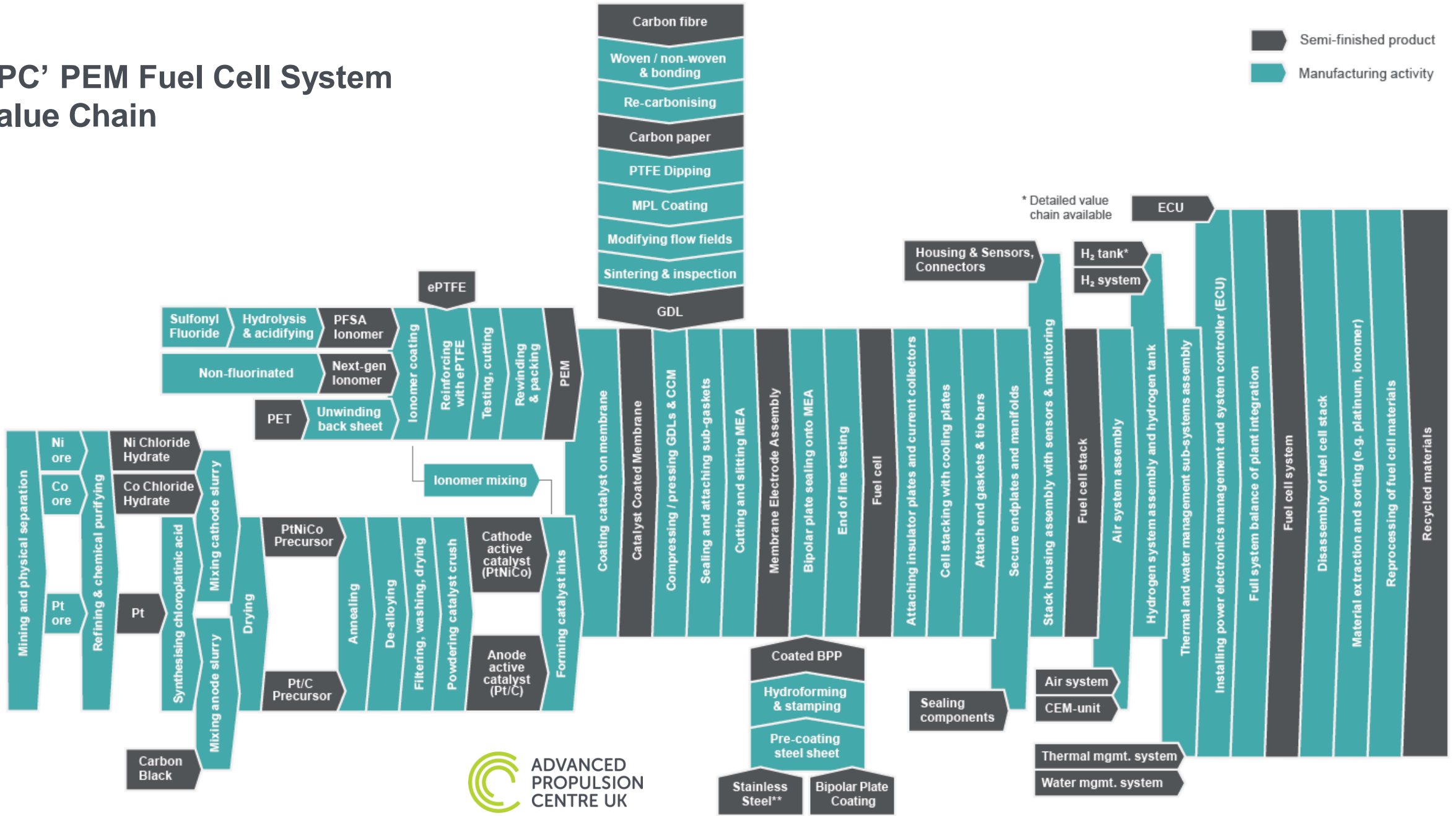
400,000

hydrogen on-board tanks

required by UK vehicle manufacturers by 2035 for cars and vans produced in the UK



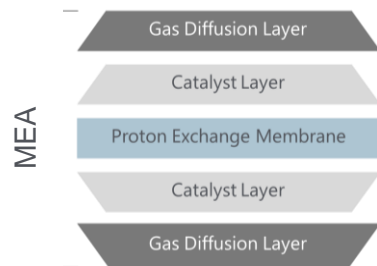
APC' PEM Fuel Cell System Value Chain



Anchored by world-leading upstream suppliers based in the UK

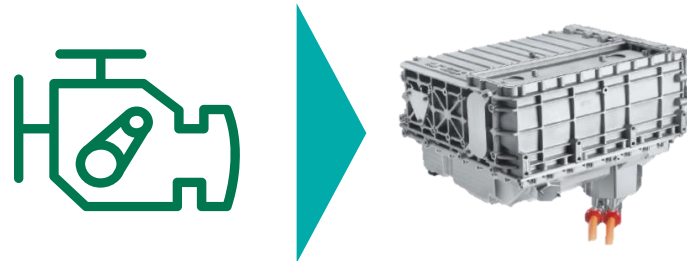
The UK has the right assets to transition into high-volume fuel cell stack and system manufacturing, complementing a strong high-value material supply chain.

Anchored upstream strengths



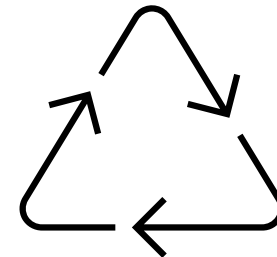
UK players already supply catalyst coated membranes, carbon paper for GDLs, and full MEAs into international markets

From ICE to stack manufacturing



Fuel cell stack assembly is one of the main opportunities to transition the UK's existing internal combustion engine plants

Existing recycling ecosystem

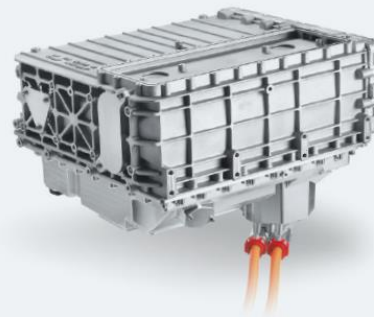
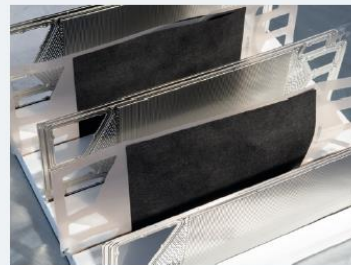


The UK has world-leading capability in recycling and remanufacture of high-value materials such as platinum group metals

The APC's value chain ambition puts the UK on the map for foreign investments

Development of the UK's fuel cell value chain offers attractive opportunities to international players considering fuel cell scale up in Europe.

Fuel cell system – key parts



Opportunities in **low-energy carbon fibre** manufacturing



Department for
Business & Trade

The UK supply chain would benefit from having a local **GDL** manufacturer

Membrane electrode assembly
including gas diffusion layer, catalyst layer, and proton exchange membrane

Fuel cell stack

Inward investment from Tier 1s and/or OEMs in **stack assembly & bipolar plate stamping**

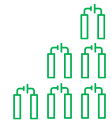
Hydrogen tanks

Scale up opportunities and collaborative R&D for **improved packaging of H₂ tank systems**

Key messages



Modular electrified vehicle platforms will provide greater powertrain flexibility for OEMs and accelerate investments in hydrogen fuel cell technologies for SUVs and vans



The APC forecast demand of 14 GW worth of fuel cell stacks and 400,000 hydrogen tanks by 2035 from UK production of SUVs and vans alone



The UK has key strengths and assets across the value chain that the APC wants to leverage in an ambition where the UK supply chain generates 65% of the fuel cell system and tank value-add



The APC believe that the UK supply chain can support growth in fuel cell markets around the world, especially in high-value materials such as membranes, catalysts and carbon fibre



The APC welcome international collaboration in fuel cells and tanks, and the value chain ambition promotes the UK higher up the target list of international players considering fuel cell scale up in Europe

Contact APC for further information

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